U.S. DEPARTMENT OF COMMERCE
National Telecommunications & Information Administration

Evaluation of the
Telecommunications and Information Infrastructure Assistance Program

Case Study Report

Dakota Telemedicine System
96092

Bismarck, North Dakota

Site Visitor: Kyle Snow

Dates of Visit: June 3-4, 1999

PREFACE

The following case study report is being issued as part of TIIAP's ongoing evaluation initiatives designed to learn about the effects of TIIAP funded projects. This report is one in a series of twelve based on in-depth case studies conducted in 1999 to study three subjects: (1) issues particular to rural communities (2) issues particular to urban communities, and (3) challenges in sustaining information technology-based projects. The case study reports give us evidence about the special challenges that each project faced and provide information for a better understanding of factors that can facilitate the success of such projects.

In addition to being urban or rural, the case study projects were selected because they involved distressed communities, represented innovative models for services, and affected measurable community outcomes. The case studies, conducted under contract by Westat, an independent research firm, consisted of extensive review of project files and records, interviews with project staff, representatives of partner organizations, and project end users. In addition to the 12 individual reports, a summary of findings across the projects is also available on the NTIA website.

NTIA wishes to thank the case study participants for their time and their willingness to share not only successes but also difficulties. Most of all, we applaud your pioneering efforts to bring the benefits of advanced telecommunications and information technologies to communities in need. We are excited about the case studies and the lessons they contain. We believe that these projects provide a unique insight into the variety of ways to eliminate "the digital divide" which exists in our nation. It is through the dissemination of these lessons that we can extend the dividends of TIIAP funded projects nationwide.

We hope you find this case study report valuable. You may obtain other case study reports, a summary of findings of the collected case studies, and other TIIAP publications through the NTIA website (www.ntia.doc.gov) or by calling the TIIAP office at (202) 482-2048. We also are interested in your feedback. If you have comments on this, or other reports, or suggestions on how TIIAP can better provide information on the results and lesson of its grants, please contact Francine E. Jefferson, Ph.D., at (202) 482-2048 or by email at fjefferson@ntia.doc.gov.

Stephen J. Downs, Director

Telecommunications and Information Infrastructure Assistance Program

Project Name	Dakota Telemedicine System
City/State	Bismarck, North Dakota
Grant Recipient	Medcenter One Health Systems
OEAM Number	96092
Application Area	Health
TIIAP Grant Amount	$749,875
Match Amount	$1,728,419
Date of Site Visit	June 3-4, 1999
Site Visitor	Kyle Snow
Abstract	Medcenter One Health Systems developed the Dakota Telemedicine System (DTS) to connect a central hospital (Medcenter One) to the Veterans Administration Hospital in Fargo and 10 remote sites. The project is partially funded by grants from the Rural Utility Service, as well as the TIIAP grant. North Dakota is characterized by a predominantly rural population that is underserved by medical services, typically located in major towns or cities that may be quite distant. Through telemedicine, primary care providers in remote clinics can obtain immediate consultations with specialists at larger care facilities before making diagnoses or transferring patients to major facilities for treatment. Additionally, patients may consult with specialists for follow-up care from a remote site. The system utilizes dedicated T1 lines to connect remote sites to Medcenter One, an integrated medical care facility, and each other via a bridge located at the hub site (Medcenter One). The system uses teleconferencing equipment to provide its services. Dedicated analog telephone lines are also used to arrange consultations and fax patient records from site to site. Currently Medcenter One serves about 5 percent of its patient population through telemedicine consultations. During the time of DTS, the referral rate from local clinics has declined, as more patients are treated in their own community. Patients and doctors are generally positive about telemedicine, both noting its convenience for the patient (and in some cases the doctor) as important outcomes. The only problems experienced by the project have been in getting sites connected as the infrastructure within the state develops.

A.   Background

Community Characteristics

The state of North Dakota is one of the most rural in the nation. The majority (59 percent) of the population lives in communities of less than 10,000 people. Access to health care for North Dakotans outside of urban areas is poor. Forty-three of the 53 counties in the state have been designated either partial or full health professional shortage areas. The state also has a large number of older adults (14.3 percent in the state, 12.6 percent nationally). High levels of poverty also mark the state: 13.8 percent live below poverty, and 36.4 percent live at less than twice the poverty line. North Dakota and surrounding states have high concentrations of veterans: 43 percent of the veterans are over age 65, and 7 percent are disabled. Despite the high need for health care, there is only a single Veterans Administration (VA) facility, located on the eastern border of the state in Fargo. Given how dispersed the population is and how difficult travel can be in the northern plains during winter months, together with the shortage of medical professionals in the state, providing access to quality care in local communities is a high priority for medical facilities in the state.

Project Overview

Problems/Disparities the Project Was Designed to Address. Due to the degree of isolation between rural, outlying communities and larger towns and cities, access to high-quality, specialty medical care is limited. Prior to the introduction of telemedicine, patients needing specialty care would need to be treated at one of a small number of large hospitals, possibly hundreds of miles from their homes. Similarly, once treated, they would have to travel the same distances to conduct follow-up visits with a specialist. Because of the time and inconvenience associated with such isolation, many patients avoided medical care or follow-up. For example, according to the project proposal, nationwide, veterans living within 5 miles of a VA hospital were more than twice as likely to utilize its facilities for acute medical and surgical care than were veterans living more than 5 miles away (3.4 percent versus 1.5 percent). The introduction of telemedicine allows general practice doctors at rural clinics or hospitals to consult with specialists hundreds of miles away, frequently avoiding the need to transfer patients to the larger, more distant facilities for initial or follow-up care.

Technical Approach

The Dakota Telemedicine System comprises a closed system, linking videoconferencing equipment at each site via dedicated T1 lines.[1] The videoconferencing equipment consists of camera and microphones, dual monitors, a document camera, and inputs and outputs for videotape recorders. Computers may also be connected to the system. The system is not Internet-based (at the current time), but rather is controlled by an icon-based control panel and stylus. Each of the remote sites is connected via a bridge at Medcenter One, which serves as the hub for the system. Each site is also connected to the hub via a dedicated analog phone line through which scheduling is achieved.

To initiate a telemedicine session, a remote site telephones the hub requesting a specific service (e.g., a orthopedic consultation). In some cases there is an emergency and an immediate connection is needed. In other cases, a consultation is scheduled. Currently, the scheduling process requires a number of phone calls (usually two) between site coordinators at the hub and spoke locations. At Medcenter One this also requires contact between the site coordinator and the individuals who schedule the specialists. Once a time and date are determined by the site, the doctor, and the patient, the session is set in a master schedule at the hub location. Prior to the consultation, the patient's medical history is updated at both the remote and hub sites, either via fax or mail, depending upon the urgency.

Once in place at the telemedicine center at Medcenter One, a specialist is able to connect via telemedicine to the requesting physician at the remote site, and the consultation takes place. Using the telemedicine equipment, the doctors can see physical symptoms in the patient, closely examine wounds or physical limitations (e.g., range of movement tests in orthopedics), or share other visual information. There are three types of consultation that take place: scheduled (nonemergency, typically follow-up visits), emergent (noncritical, nonscheduled consultations with a rapid turn-around), and urgent (emergency consultations). Additionally, because the hub site is equipped with a video recorder, it is possible for physicians at remote sites to present the patient for consultation even if a specialist is not currently available. When the specialist arrives, he or she reviews the tape and then responds.[2]

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[1] In this context, "closed" means that the equipment is connected by dedicated T1 lines that carry no other signals. The system is closed because there is no way to access it outside of each site's location. Additionally, the system is not web-based, so there is no possibility of unauthorized access via the Internet.

[2] This is a capability of the system that is not frequently used.

In addition to consultations, the telemedicine equipment was used for support group meetings and for educational purposes (detailed later). In these cases, the event was scheduled in advance and the equipment arranged to accommodate a larger number of people on camera with audio. In all cases, medical consultations took precedence over these prescheduled events.

Although each site's physical layout is different, all sites have telemedicine equipment located in a secure room that offers both privacy and convenience to participating doctors. In some sites there is adequate room for a patient to be brought in while still on a gurney. At least one site had used a portable unit (a roll-about) that was easier to move than the larger equipment cart in place in the other sites. Currently, at Medcenter One, a single unit is located within a suite of offices.[3]

Anticipated Outcomes

There were a number of anticipated outcomes listed by the project director. These included:

- **Increase access to care.** The project expected that there would be an increase in the number of patients seen by physicians in remote sites, and by specialists through consultation at Medcenter One.

- **Alter referral patterns so that more patients are treated locally.** The project expected that the number of referrals to out-of-area medical facilities would decline during the project.

- **Improve the quality of care at remote facilities.** This was linked with decreasing the number of referrals; providing care on site rather than out of area was one sign of improved quality.

- **Impact treatment through consultations between primary providers and specialists.** Primary care doctor consultation with a specialist was expected to impact the number of initial diagnoses that were changed. The expectation was that specialists would help to provide more definitive diagnoses than initially given.

- **Increase patient satisfaction with care.** Patients were expected to view experiences with telemedicine favorably and comparable to their expectations of telemedicine and consistent with their ideas about quality care.

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[3] The project currently has plans to install a second telemedicine unit at Medcenter One.

Project Status at the Time of the Site Visit

At the time of the site visit, the project was ongoing, having just received a no-cost extension to the grant until September 1999. The project was in the midst of expanding the number of partner clinics, as well as expanding its utilization of the telemedicine system to include more diverse activities. The Dakota Telemedicine Project has received funding from both TIIAP and RUS. Both of these sources contribute to the basic infrastructure and operations of the system (e.g., providing the multipoint bridge, personnel, etc.). Thus, all sites within the system benefit from the TIIAP grant, even if a particular site receives funding primarily from RUS. At the time of the visit, there were nine sites on-line, including the hub site at Medcenter One in Bismarck and the VA hospital in Fargo. One additional site funded by RUS was being completed, and three additional sites (one funded by TIIAP, two funded by RUS, including a second site at Medenter One) are pending installation. This will bring the total number of sites up to 12 in the system, including the VA in Fargo and two units at Medcenter One in Bismarck.

B.   Community Involvement

Characteristics of the Grant Recipient Organization

The grant recipient is Medcenter One Health Systems; a large integrated tertiary care facility located in Bismarck, North Dakota. Medcenter One provides the full range of medical care, from emergency medicine and trauma to surgery and chronic care. Organizationally, the telemedicine program falls into the outreach arm of Medcenter One, and was recently reorganized under the aegis of Physician Support Services, Medcenter One developed the Dakota Telemedicine System (DTS) in 1995, connecting community hospitals in Linton, Wishek, and Bowman to Bismarck (as the hub). A site on the Standing Rock Sioux Reservation (Ft. Yates) was being installed at the time of the grant. At the time of application, the DTS had already handled more than 250 specialty consultations. At the hub site is a full-time medical director as well as a telemedicine coordinator and support staff. The DTS also employs a site coordinator at each site to serve as the technical and secretarial support for the site.

Partnerships

Veterans Medical Center-Fargo. A primary partner of the project is the VA hospital in Fargo. The Telemedicine project equipped the hospital with teleconferencing equipment and technical assistance. Medcenter One was named as a primary care provider in conjunction with the VA hospital, allowing patients to receive many of the services the VA provides at Medcenter One. Currently, VA patients can utilize Medcenter One as a remote telemedicine site to connect with their specialists in Fargo. Medcenter One can perform many of the needed tests, though patients are referred to the VA when needed. The partnership is expanding as the telemedicine project is exploring ways of implementing patient electronic records. The VA currently has a model system in place that the project is considering for adoption.

Rural Clinics and Hospitals. The project operated out of the following seven clinic sites that are either affiliates of Medcenter One Health Systems, provide contract services, or are otherwise unaffiliated directly with Medcenter One Health Systems:

- St. Luke's-Tri State Hospital – Bowman (contract services; RUS)

- Standing Rock Hospital - Ft. Yates (not affiliated; RUS)

- Carrington Health Center – Carrington (not affiliated; RUS)

- Dickinson Clinic – Dickinson (affiliated; TIIAP)

- Linton Medical Center – Linton (not affiliated; RUS)

- McKenzie County Hospital – Watford City (contract services; RUS)

- Wishek Community Hospital – Wishek (not affiliated; RUS)

Once on-line, each of the remote sites collaborates with Medcenter One to provide telemedicine services. Since many of the remote clinics are affiliated or contracted for services with Medcenter One, this relationship is a natural one and Medcenter One maintains a great deal of the costs as part of their operation. Remote sites that are not affiliated with Medcenter One are currently funded by other sources. Regardless of affiliation, the relationships between Medcenter One and the remote sites is fairly consistent. The remote sites receive patients from the community and utilize telemedicine to consult with specialists in Bismarck. Many of the specialists in Bismarck also spend time in the remote clinics/hospitals providing direct care. Thus, telemedicine allows for emergency consultations but also augments care by allowing specialists to

have follow-up visits over telemedicine, continuing relationships with patients developed at the remote site.

        Other Partners and Key Service Providers. The technical aspects of this project relied upon two levels of support. First, although not formal partners, the telephone companies serving North Dakota worked closely with project staff to develop the necessary infrastructure. The telecommunications infrastructure in North Dakota at the beginning of the project was not well established, and deregulation of the telecommunications industry had only recently resulted in the emergence of a number of small, local carriers. In some cases, the carriers provided technical assistance to the project, but in others, the project provided some of the technical assistance to the carrier.

The project also worked closely with an electronics vendor located in Chicago, IL, the retailer for the videoconferencing systems used by the site, as well as the bridge and computer equipment. Additionally, the vendor provided a great deal of technical support and training for project staff. This was especially important for the project because initially the project director did not have expertise in the technology. Through the support of the vendor and her own initiative, the project director quickly became knowledgeable about the technology, enough to provide some training to the telecommunications carriers.

Community Outreach

Involving Community Stakeholders. From the beginning of the project, efforts have been made to involve state and national government leaders. The project director has been very active in soliciting and obtaining the support of local and national political figures. Medcenter One has a strong community presence through its outreach programs. These programs include Parish Nurse, a program connecting nurses to local churches, and Medcenter One Foundation, a program sponsored by Medcenter One to raise funds through local businesses to provide medical care and equipment. Currently, there is no particular emphasis on involving community stakeholders with telemedicine specifically, although the director plans more active community involvement in the future (see Project Expansions, below).

Needs Assessment and Feasibility Study. Prior to beginning telemedicine services in 1995, Medcenter One spent nearly 3 years in research and development. This research used state and national census data to document the need for more available medical care, especially among veterans and members of outlying areas (see Community Characteristics, above). Additionally, because Medcenter One already had relationships with most of the rural facilities in the project, both sides were aware of the needs and capabilities of the other. The remote sites and Medcenter One worked together to develop the plans for implementing telemedicine in the system. From its inception, a core of doctors was invested in developing the telemedicine system.

Once the organization had made a commitment to telemedicine, some feasibility testing of possible system configurations began; for example, early on the project compared the performance of two videoconferencing systems before selecting one as the appropriate technology. The project director pointed out that the feasibility testing of the technology was at least as much about generating physician buy-in as they were testing the equipment. During the

early feasibility testing the equipment was used for demonstrations in efforts to recruit more doctors as potential end users of the system once it was in place.

Project Outreach. Prior to the beginning of the project, care providers at each of the project locations (including Medcenter One and the Fargo VA hospital) received information about telemedicine and were invited to participate in a demonstration of the system. Initially, the community was informed about the Telemedicine project through news media stories, including newspaper and television interviews. In general, patients would be told about the project only if their condition warranted the use of the system. When the care provider felt that there was need for further consultation (cases he or she would otherwise refer to the hospital in Bismarck), the patient would be told about telemedicine and would be given the option of using the system. In emergency consultations, the patient may or may not have known about telemedicine prior to its use.

Most of the additional outreach from the project was filtered through the local clinics/hospitals. For example, the continuing education teleconferences (e.g., surgical grand rounds), special education programs, and diabetes support groups were all advertised using fliers in the sites. Project staff felt confident that potential end users knew about telemedicine in their communities, especially if they used the local clinics for care.

Training. One of the unique features of this project is that key project personnel acknowledged little technical training or background. Typically this is a substantial liability. In this project, however, it was not, for several reasons. First, the technology most encountered by the users (physicians and patients) is videoconferencing equipment, which offers an extremely easy interface. Second, at each site a particular person has been identified as the telemedicine coordinator. This person typically handles all of the details of the technology for the site, easing the need for all people on site to be trained. Third, the people with most contact with the underlying technology were either trained by the local electronic vendor (who also provides technical assistance) or learned by doing. These key people on the project had knowledge of what the system was capable of and how to solve most problems, even if they individually lacked specific, highly technical knowledge. It was clear that the technical aspects of the project were well managed.

Protecting Privacy. Issues of security and privacy seemed of little concern to the project. The Dakota Telemedicine System is entirely closed. It comprises dedicated lines connecting sights via a bridge at the hub location. There is no interface between the system and

the Internet, and the only way into the system is to be connected to the hub, which occurs either at an appointed time (as for consultations) or following a phone call for assistance (for emergency consultations). These calls, as well as fax transmissions' all occur over dedicated telephone lines, again enhancing security. At each location, the telemedicine equipment is located in areas that allow for privacy, typically small conference rooms or other spaces. While this physical arrangement allows for privacy, the system is designed to be portable and may be moved to more or less private settings as needed. Additionally, at least one doctor noted that the previous system, involving faxing patient information from site to site, was no more secure than the current system, and the advantages of the telemedicine system far out weigh any privacy or confidentiality concerns that he would have.

Patients who use telemedicine in this project do sign a consent form. Among other things this consent form acknowledges that they are being treated through telemedicine and gives the project permission to videotape all activity on the system. These tapes are then catalogued by project staff and kept for later reference as needed (either by the physicians on the case or to confirm quality of care). Currently this consent to participate and be videotaped falls under one disclaimer, but project staff acknowledged that a patient consenting to telemedicine but not videotaping would receive care and not be videotaped.

C.   Evaluation and Dissemination

Evaluation

The evaluation plan for the project (included in the grant application) includes a set of five general objectives covering a number of specific questions. Although it is not clear from the plan, there is the potential to have both pre- and post-test data for some of these questions. Additionally, the plan includes both formative and summative data. The summative data have not yet been reported, but the formative data have been utilized through dissemination products as well as internal record keeping.

The evaluation plan identified the following objectives (sample questions in parentheses):

- **User acceptance** (e.g., Were the patients satisfied with their encounter? Were the specialists satisfied with the encounter/consult? Do they feel the technology saved time or money?)

- **Effectiveness** (e.g., How many patients required referral outside of the community following the consultation? Did the diagnosis of the PCP change after the telemedicine-mediated consult?)

- **Utilization** (e.g., How many times was the equipment used and for what purpose? How long from the time of referral did it take to get the response from the consultant to the primary care provider site?)

- **Cost** (e.g., What were the total operating costs for the demonstration project, by site, by application, by modality? What was the average cost for each application by each mode of transmission (T1, 384)?)

- **Capacity/reliability** (e.g., How many system/equipment failures occurred and what kind were they? Did equipment failure materially affect the provision of services?)

The project is using a number of data collection strategies. First, information about the patient and the medical course of the consultation (including its purpose, which physicians were involved, and the outcome) is taken from the medical records that are otherwise kept by the hospital. Information about physician and patient satisfaction with telemedicine is taken from surveys completed by each after the consultation is completed. Budgetary items in the evaluation are assessed using the hospital billing system.

Although data bearing on each of the evaluation objectives (and the specific questions under them) are available to project staff, the current mode of data collection and database development are ponderous. Currently, most of the data are transmitted on paper via fax to the hub site, and are then manually keypunched into a database. As the number of contacts and other uses of the system increases, this task will likely become much more daunting (as the site coordinator acknowledged). The project is currently exploring the possibility of adapting the VA electronic patient record, which would ease much of the task demands for data management (see Project Expansions, below).

Dissemination

Information about the Dakota Telemedicine project has been widely disseminated. First, as planned in the original proposal, a number of articles have been prepared for and published in professional medical journals, including *Annals of Emergency Medicine, Telemedicine Journal*, and *Clinical Orthopedics and Related Research.* The project also has featured prominently in a number of other professional publications, such as *Rural Health, Telemedicine and Telehealth Networks,* and the American Psychological Association's *Monitor.* The site has also won a number of awards, all accompanied by wide-ranging publicity, including Outstanding Program of the Year, Center for Rural Health (1997); Excellence Award-Telemedicine Application of the Year, NTIA (1997).

D.   Problems Encountered

Lack of Telecommunications Infrastructure in North Dakota. The project was originally designed while a single telephone company provided all line service in the state. After the grant was awarded and the state telecommunications industry was deregulated, a larger number of local companies took over service in many areas. While the project had been designed with the capabilities of a single provider in mind, now the project had to cope with a number of companies using different products with varying levels of technical expertise. This caused delays, either in installing lines or in maintaining the lines once installed. Additionally, different companies were using different types of lines that need to be integrated prior to accessing the bridge at the hub site. To deal with this problem, the project director advised each provider what the necessary technology was, even if the provider had not yet worked with it. Second, the electronics vendor served as the system integrator. Although integrating a number of different network technologies caused some delay, the project director said that having an integrator in place who could accommodate a range of technologies was actually a benefit in the long run. Now the system is accessible to new connections even if the networks are not the same as those already in place.

System Is Not as Fully Utilized as Designed. The technical aspects of this project are such that it can accommodate more remote sites (based upon the number of available ports in the network bridge) and more users (due to the number of available channels). To this point the project staff have been somewhat disappointed that the system has not been used as much as it could be. Project staff and participants feel that as more physicians try the system, more will use it. The project director also noted that physicians at remote sites and project staff at

Medcenter One had a number of ideas about expanding the scope of services provided via the system, but the staff is currently too small to actualize many of these ideas.

Physical Constraints. As previously described, in each site the telemedicine equipment is located in a specific location. In some sites the location is centrally located and provides ample space for physicians and patients, or small groups for specific programming. In others, the room is quite small, or is also a conference room needed at other times for meetings. Doctors at one site suggested that if the equipment were nearer to the emergency room then they would likely use it more, while doctors in another site suggested that if the equipment were located in a larger room, they would be able to use it more for patients. One potential solution, a roll-about unit, was requested by one site but then later exchanged for the larger system used by the other sites because the video images were too small. Most sites have not suffered due to the space constraints, though it is clear that the location of the equipment varies from site to site, largely based upon where space is available rather than where the unit can be most conveniently located.

E.   **Project Outcomes**

Impact on End Users

In the Dakota Telemedicine System, patients and doctors both received benefits as end users. Specifically, because consultations were typically arranged to occur between primary care physicians and specialists, with the patient present, the physicians were end users and the patients were secondary beneficiaries. In other instances, patients made appointments for follow-up consultations or other appointments with specialists. In these cases, specialists and patients were end users.

Impact on Patients. Overall, about 5 percent of the patients served by Medcenter One are seen via telemedicine, either through direct consultation with specialists or through consultations with specialists arranged by primary care physicians. In cases of direct consultation, patients were the end users. This was particularly the case for patients receiving mental health care or follow-up therapies. After each telemedicine consultation, the patient would complete a satisfaction survey. These have been overwhelmingly positive among patients receiving direct consultations with their specialists at other sites. Many patients respond with open comments about the ready availability of seeing their doctor over telemedicine versus having to travel great distances for what are typically very short follow-up visits. Patients were especially comfortable seeing a specialist via telemedicine if they had previously seen that specialist in person at least once.

While it is clear that many of the patients seen through telemedicine are saving a great deal of time and expense by staying in the local community to receive care, the impact on the quality of the care relies more upon physician and patient satisfaction. From the data collected via patient satisfaction surveys and onsite interviews with doctors, it is clear that both groups are generally satisfied with telemedicine. The project also tracks any impact consultations have on initial diagnoses (number of changes in diagnosis after consultation). These numbers, too, suggest an impact of telemedicine on the patients as some diagnoses are altered following consultation with the specialists. Additionally, the number of referrals to Medcenter One from remote clinics has declined over the course of the project, suggesting that patients are able to receive prompt, appropriate care in their local facilities. In 1998, only 6 percent of patients seen via telemedicine were transferred and treated outside of their own communities.

Impact on Physicians. Most typically, the end users of the Telemedicine project were the physicians, both primary care and specialists. In 1998, the most recent year for which data were available, 33 individual doctors plus doctors at the VA hospital used the telemedicine system for consultations, though they varied in how frequently they consulted. One doctor in a remote clinic accounted for 17 percent of the consultations, and one specialist at Medcenter One accounted for 16 percent. Most of the doctors using the service, however, had fewer than 10 consultations in the year. There were also substantial differences in system use by area of specialization. Nephrology (17 percent), mental health (16 percent), and dermatology (13 percent) were the three most common specialty consultations.

Most of the doctors reported that using the telemedicine system was advantageous to their delivery of services, though most also pointed out that there are particular cases where the system is especially suited for use and others where it is not. Several doctors made it clear that being situated next to a patient, regardless of the patient's need, was preferable to seeing the patient over telemedicine, but often the choice is between telemedicine and not seeing the patient at all. All thought that the system allowed them to have more contact with more patients, both through telemedicine and in person, because it allowed them to work more efficiently. In some cases, telemedicine allowed specialists to provide care for a small number of patients at a remote site without leaving the hospital, allowing the doctor to save time otherwise spent traveling between sites.

Doctors in the remote sites also benefited from the system by expanding their medical skills, if only in a somewhat limited way. For example, when the primary care doctor sits

in on a consultation between a diabetic patient and the specialist at Medcenter One, the doctor learns about new therapies and research that he or she might not otherwise know about. Additionally, at least one doctor noted that having the telemedicine system available, even if he does not use it for a number of days, is a security blanket. He knows that if he needs help in treating a patient, there is a specialist available for consultation. This doctor also noted that this availability provides a sense of "team" that doctors at small rural sites often do not have.

Impact on Other End Users. Two unanticipated types of end users have emerged as the project expanded in scope (see Project Expansions, below). One group of 12 students is completing coursework in interpretive sign language as part of a certification program. This is a program that would not otherwise exist, so the completion of the program itself is an important outcome for these students. Another student completed a supervised social work internship through the project. Again, she could not have met her course requirements without the project.

Impact on Other Beneficiaries

The larger community also stands to benefit from the Dakota Telemedicine System, though demonstrating this is more difficult. However, several of the physicians, and the project director all noted the impact on the community. They saw the provision of high quality, specialized care as an instrument in building the economic base of a community. As they expressed it, people and companies are reluctant to locate to a community that lacks quality schools and medical care. Telemedicine allows the rural clinics to provide quality care, in the community, thereby keeping people in the community they would otherwise leave.

Impact on Grant Recipient and Project Partners

There are several levels of impact the grant has had on the recipient and its partners. The first is that new partnerships were formed. The working relationship between the VA and a public hospital is a model for similar collaboration nationwide. Through this partnership, the VA has been able to designate an additional resource for veterans in the state who cannot travel to Fargo. In exchange, Medcenter One has found a market for its services that was previously inaccessible. The two hospitals are also working together on electronic patient records that will benefit both. At an individual level there has also been an impact, as physicians have forged relationships not otherwise possible.

The project has also impacted the remote sites. First, by providing the technology, sites have been able to utilize the system for its primary intent (improving delivery of medical care), but they can also utilize the technology for other applications. As with the VA, new relationships were formed between staff at each location. Additionally, doctors at the remote sites are more comfortable being isolated physically when they know they can access specialists via telemedicine. There is a sense that telemedicine makes the outlying clinics more clearly extensions of the primary hospital.

Replication

The project director has become well known in the telemedicine community, which has produced a great deal of interest in the Dakota Telemedicine project. She is frequently sought for informal and formal guidance and consultation. A number of hospitals and communities have developed telemedicine models based upon the model developed in Medcenter One, including Henry Ford Hospital in Detroit, Rapid City Regional Hospital, and St. Paul Burn Center in Minnesota.

F.   Sustainability and Project Expansion

Strategies Used to Maintain Project Activities Beyond the TIIAP Grant Period

The primary strategy for sustaining grant activities is the pursuit of additional grant monies. Medcenter One has a proven record of grant awards, including a Rural Utility Grant to establish the system in 1995, and a Rural Utility Grant in 1997 to expand the number of sites included in the system. Additionally, the project is considering plans to make the teleconferencing equipment available to local business for a fee to conduct teleconferencing meetings, interviews, etc. When these services are in place, they will generate some operating revenue. Until then, a combination of other grants and corporate (Medcenter One) funding will provide for the costs associated with continuing the project.

Project Expansions

Direct service to patients accounted for 75 percent of system usage in 1998. The remainder of the time the system has been utilized in many ways that are expansions of the project scope. First, Medcenter One uses the teleconferencing equipment to conduct preliminary interviews with prospective physicians (4 percent of system use in 1998). The physician recruiter noted that this saves the hospital the expense of conducting onsite interviews with doctors who are no longer viable candidates after early interviews. The ability to conduct preliminary interviews with physicians who are "on the border" enhances the overall quality of the physicians who are invited to visit the hospital.

A second expansion of the project occurred when a distance education program on interpretive sign language lost its original hosting service, and had to find a replacement system. Medcenter One made available its teleconferencing system in North Dakota, allowing students in the state to participate in the sign language training program.

While on site, a number of other examples of additional uses were mentioned. Two groups of emergency medical technicians from geographically distant regions conduct monthly meetings over the system. Recently a lawyer in Bismarck connected with attorneys in Chicago to be deposed in a court action. A student in social work was able to connect to a clinician at one site while the student served an internship at another. The project director is anxious to exploit the growing need for teleconferencing by offering the use of the equipment to local business.

G.   Lessons Learned and Recommendations for Other Communities

Having an Integrated Medical Center at the Core of a Telemedicine System Is Essential. The project manager felt that because Medcenter One is a fully integrated medical system, able to respond to nearly all medical needs, it was in a better position to serve as the hub of the telemedicine project. This is in contrast to a number of telemedicine systems that provide specialty care in a small number of medical areas only (e.g., a system linking hospitals to cope with early neonatal apnea and other forms of distress). Because the goal of the project was to enhance all medical care for patients in outlying areas, having the ability to provide a range of care is essential to the project's legitimacy.

Know the Technology. The project director made it clear that understanding what technology was needed to do the job was essential, especially in a state with relative poor infrastructure (both materials and skills). She was often in a position of working with service providers who knew less about the technology than she did. This put a high premium on the project's ability to determine what technology was needed.

Keep the System Simple, Reliable, and Flexible. Partly because the project operated in an environment with a developing infrastructure, there was a high premium on developing a system that was not more complex than it needed to be. The project's choice of easy-to-use videoconferencing equipment was partially the result of this mentality. The simplicity of the system, which makes it possible for nearly anyone to learn how to use the equipment, greatly increases the number of possible end users by removing technology barriers to access. Also, the simplicity of the system adds to its reliability. With a simple, direct system, the number of possible problems is greatly reduced, and when problems do occur, they tend to be easier to locate in simple systems. Additionally, the project has invested in technology that allows for the growth of the project. For example, the bridge in place at the hub site is perhaps the most critical piece of technology in the system, and it has room for expansion as needed (i.e., as more remote sites come online). Finally, although the project has a focus on telemedicine, the fact that videoconferencing is the mode of delivery has not been lost, as the project takes advantage of the videoconferencing equipment in ways not directly related to telemedicine (e.g., the interpretative sign language class).

Putting in the Work Ahead of Time Has Long-Term Dividends. The project spent 2 years in research and development before any implementation began. This time was valuable because it allowed the project to test the feasibility of multiple systems, as well as develop plans for how the system would be used. Not only did this allow the project to avoid "reinventing the wheel," but it also created a relationship between the project and end-users that contributed to their buy-in of the project. Indeed, the field testing of alternative videoconferencing systems played a large role in communicating to the physicians that the system was there for them, and their opinions about how it would work were important.

Communicating with End Users Is a Two-Way Street. In this project, communication between the project at the hub site and end users in remote sites flows in both directions. The project encourages sites to raise both problems with the system and ideas about what services to provide via the system. Medcenter One does not dictate what services are offered, but is responsive to the needs and desires of users at the remote sites. The project also

involves the remote sites in marketing and research activities. For example, many sites have played roles in Medcenter One's marketing of the project, participating in videoconferencing demonstrations to funders and community groups. Likewise, Medcenter One provides remote sites with data about use, and feedback about patient satisfaction. The project director points out that by listening to the project partners, the project avoids building features or services that the end-users would not use, and is also able to call on the end-users to identify which service models work and so do not need to be recreated.

Know What Data to Collect and How to Use Them. Telemedicine sites by necessity collect data. Gathering data about a patient's medical and family history, monitoring which services he or she receives for the purpose of billing, and arranging visits with medical professional are all requirements of a medical delivery system. So, the project has a large set of data that it must collect. Keeping everyone informed about the procedures to manage all of this data may be a difficult task, but the project director sees clear advantages. First, by developing a standard reporting system, the quality of the data is higher. The reliability is also higher if there is a set standard. In this project, there were site manuals providing all of this information. The data collection approach taken by Dakota Telemedicine related directly to its approach to communication among project partners: everyone is informed. The data collection system is being further developed by the site as it pursues electronic patient records, in this current phase in its approach to data collection.

Existing Procedures Must Work with New Technical Approaches. As previously outlined, there are a number of steps that must be taken between the time a patient arrives at a remote site and is determined as a potential telemedicine patient, and the time that the patient is seen by a specialist who has all of the patient's medical records and information. The system currently in place at Medcenter One to take all of these steps is not fundamentally different from what steps would be taken to see the patient as a referral from the remote site prior to telemedicine. That is, phone calls are made, appointments made, records faxed or mailed, etc. Although seemingly ponderous, because this information exchange occurs in the same way as before, it is actually quite efficient. The project, however, is aware that the system can be made more efficient, and is pursuing electronic patient records as one means of doing so.

H.   Summary and Conclusions

The Dakota Telemedicine system is a very successful program. It is a powerful application of technology to a critical problem in the state. The number of awards it has received from numerous agencies reflects the high value placed on it by others. In this section, some of the potential reasons for the program's success are presented. These reasons may be instructive for other communities facing a similar need and/or considering the development of a telemedicine system to serve those in the community.

The Site Staff Knew It Was Needed and Would Be Used. Medcenter One was providing integrated medical care for patients throughout the state, either through its main hospital in Bismarck or through its affiliated rural clinics, long before developing the Dakota Telemedicine system. The hospital staff knew the needs of its patients, and from a history of working with physicians in the field knew how to work with their care providers. The needs assessment performed by Medcenter One confirmed what they already knew about the need for care in rural areas. The support for the system came from both doctors at the hub site as well as doctors in the clinics. Indeed, the development of the project has been through an exchange of ideas between remote sites and Medcenter One.

Telemedicine, Though Revolutionary, Was Not a Paradigm Shift. Telemedicine was seen as an extension of how medical care may be provided. As noted above, Medcenter One and its affiliated doctors viewed telemedicine as an extra option in treating patients. It was not seen as a replacement for doctors or rural clinics, rather as an extension of their ability to serve patients in their own communities. Further, several doctors noted that telemedicine's usefulness only extended so far, and that not all patients could benefit from it. In short, telemedicine did not fundamentally shift the way doctors saw themselves or how they performed, but allowed them to perform more efficiently or more effectively. To them it was a natural extension of medical practice that allowed them to better serve some patients.

The Right Combination of Factors Includes Personnel, Technology Choices, and Support. The telemedicine project is exceptional in part because it succeeded where there would otherwise be so many reasons to struggle. The project director came to the project with little technical expertise. The telecommunications infrastructure in the state was minimal both physically and in terms of knowledgeable personnel. Videoconferencing is still not very widely used. Despite these factors, the project director developed the expertise with the help of the

equipment vendors, the physical infrastructure was gradually brought on-line, and the technology is being used without much trepidation. These factors seemed to have jelled around three critical, related decisions.

First, the choice of uncomplicated videoconferencing equipment made the technology accessible to anyone with a minimum of technical skill. The most complicated aspects of the system are the mechanisms that control the bridge for the network, and much of its design and implementation was done by the vendor who then provided technical assistance to members of the project staff who were willing to learn.

Second, the choice of videoconference equipment was made by those who would be using it—the doctors. This, together with the role played by physicians in the development of services for the system, created a sense of common purpose. Decisions about the system are made with input from physicians and patients. The decision to involve physicians in planning for the system virtually guaranteed the presence of end users.

Finally, the selection of project personnel and staff development brought the pieces together. The project director is an energetic and enthusiastic advocate for the project. The fact that she has acquired the technical knowledge to run the project allows her to relate to those without the technical skills. Using site coordinators at each location relieves the technical and day-to-day activity strain from the physicians, creating a situation where all that is required is their willingness to use the equipment. Finally, doctors using the system are not directed to use it but rather see the system as valuable for their own reasons. Because of this, physicians are free to use the system on their terms, or not at all. Thus, if a doctor does not agree that telemedicine is valuable (as is the case with some at Medcenter One), that doctor does not use the system. Doctors using the system, however, become strong advocates and powerful partners in the system's development.